

## PATENT ABSTRACTS OF JAPAN

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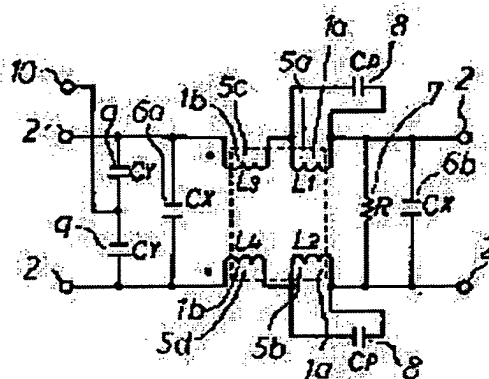
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**(54) NOISE FILTER**

(57)Abstract:

**PURPOSE:** To provide the small-seized and inexpensive noise filter which effective ly suppresses the common mode electromagnetic noise in the low frequency band and the electromagnetic noise of the high frequency band, in the noise filter which suppresses the electromagnetic noise of the common mode developed across a pair of two lines and the ground.

**CONSTITUTION:** A composite common mode choke coil 1 (1a and 1b) with at least two pairs of wirings wound around the magnetic core of one closed magnetic circuit and a capacitor 8 on both ends of a pair of wirings of the composite common mode choke coil 1. The noise filter is formed by connecting a line/earth capacitor 9 between the line and an earth terminal 10 on the input and output sides of a composite common mode choke coil 1 and line-to-line capacitors 6a and 6b between lines.



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CLAIMS

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[Claim(s)]

[Claim 1] The noise filter characterized by coming to connect the compound common mode choke coil which gave at least two or more pairs of common mode coils to the closed magnetic circuit core which has a high relative permeability property, the capacitor linked to the both ends of at least one pair of common mode coils of this compound common mode choke coil, the capacitor between lines linked to the input side and output side of said compound common mode choke coil, and a line and the capacitor between touch-down.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Industrial Application] this invention -- electronic equipment -- mounting -- electromagnetism -- it is related with the noise filter which controls a noise.

[0002]

[Description of the Prior Art] Handicraft or a winding machine was used for the toroidal core in the common mode choke coil which forms the conventional noise filter, and the coil of the round-head copper wire was carried out. In this conventional kind of noise filter, the common mode choke coil and capacitor which wound two coils around the common mode, and resistance are connected to the toroidal core of the closed magnetic circuit which has one high relative permeability property, and one noise filter is formed. On the other hand, when noise depressor effect is needed to the range of a low frequency region, it is necessary to carry out combination formation of two or more noise filters of the noise filter incorporating a common mode choke coil with the big value of an inductance, and the noise filter which has a high damping property in a RF region, and a configuration becomes large with the noise filter which needs a high damping property in a low frequency region. On the other hand, in order to give a coil to each of two or more toroidal cores and to build two or more common mode choke coils into a circuit, bad, materials cost's becoming a large sum and assembly-operation nature also had many man days of an assembly, and had become a very expensive noise filter.

[0003]

[Problem(s) to be Solved by the Invention] the electromagnetism ranging from [ in order that this invention may remove these faults ] the low frequency region to a RF region with sufficient productivity with a damping property cheap it is large and small in a low frequency region -- it aims at providing controlling a noise with the noise filter which has effectiveness.

[0004]

[Means for Solving the Problem] The field which the current which flows to the reverse sense at said coil makes negates this invention mutually to the magnetic leg to which the opening side of U typeface core is made to counter, and two or more pairs of said rectangle core counter the rectangle core of the one closed magnetic circuit magnetic substance fitted in and formed in combination and a rectangle using the coil of the cylindrical shape which wound rectangular copper wire. the so-called electromagnetism in the common mode which flows in the same direction on the other hand -- to the current by the noise, it considers as the compound common mode choke coil in which at least two or more common mode choke coils wound so that a high inductance might be produced were formed to one closed magnetic circuit. The coil wound around the magnetic leg of each rectangle core of two or more common mode coils of said compound common mode choke coil is connected to a serial. A capacitor is connected to one common mode choke coil at juxtaposition at a choke coil, and a capacitor and a parallel resonant circuit are constituted. It is made to act so that it may have a high impedance, and one common mode choke coil of another side is made to act in the specific frequency band of a low frequency region, so that it may have a high impedance in the noise generating frequency band whole region over a frequency region until it produces the self-resonance by the stray capacity between coils. Furthermore, a capacitor is connected to pi mold between two lines to the aforementioned compound common mode choke coil. moreover, the thing for which a capacitor is connected between the Rhine-grounds so that a reverse L type filter may be constituted, and the circuit of a low pass filter mold is constituted -- the specific frequency band of low frequency -- receiving -- a high damping property -- having -- moreover, the electromagnetism to a high frequency region -- a noise is controlled and a noise filter cheaply realizable small is constituted. It is also possible for it to be reversed and to incorporate before and after connection of the capacitor which connects the noise filter of this invention to a compound common mode choke coil. moreover, electromagnetism -- the frequency band of a noise -- electromagnetism -- the common mode choke coil in every \*\* of the compound common mode choke coil for controlling a noise is used as the common mode choke coil with which inductances differ. Moreover, it is possible by changing the constant of a capacitor for the damping properties of a frequency band to differ in arbitration according to a noise generating frequency component.

[0005] That is, it is the noise filter characterized by this invention coming to connect the compound common mode choke coil which gave at least two or more pairs of common mode coils to the closed magnetic circuit core which has a high relative permeability property, the capacitor linked to the both ends of at least one pair of common mode coils of this compound common mode choke coil, the capacitor between lines linked to the input side and output side of said compound common mode choke coil, and a line and the capacitor between touch-down.

[0006]

[Function] Two coils wound around one magnetic leg of two pairs of common mode choke coils formed in the rectangle core which the opening side of U typeface core was made to associate, and was combined, and the rectangle core are connected to a serial. The capacitor connected to one common mode choke coil wound around the magnetic leg which a rectangle core counters so that parallel resonance might be produced in juxtaposition in a low frequency region the electromagnetism of the low-frequency component which flows to a common mode choke coil in a low frequency region -- it is made to produce a high impedance to a noise Moreover, a capacitor is connected between two lines of the input side of the compound common mode choke coil which connected to the serial the coil wound around each magnetic leg which at least two or more pairs of common mode chokes formed in the magnetic leg of a rectangle core on the other hand counter, and an output side. Moreover, since it has considered as the configuration which connected the capacitor with two lines between touch-down, the parallel-resonating-frequency region produced by the capacitor connected to one common mode choke made into a high impedance to the current which flows on a line at juxtaposition is removed. The capacitor connected between the lines of the inductance of a compound common mode choke coil, and an input side and an output side, and two lines -- respectively -- \*\* -- the capacitor between the earth side, and the normal mode between two lines -- electromagnetism -- the common mode produced between a noise, and two lines and earth side -- electromagnetism -- the noise filter which controls a noise is

constituted. Moreover, since it has not been considered as the configuration used as the noise filter comprising two noise filters with which the attenuation frequency regions which combined the capacitor with two common mode choke coils, respectively differ, the assembly man day at the time of the number of the capacitors which form a noise filter decreasing, and assembling the magnitude of the whole noise filter and components also decreases compared with the former, and the big noise filter of a damping property can consist of a small and cheap low frequency region and a RF region.

[0007]

[Example] One example of the noise filter of this invention is explained using a drawing.

[0008] One example of the circuit which constitutes the noise filter of this invention in drawing 1 is shown. It makes [ as shown in drawing 4 (b), the compound common mode choke coil 1 comes to include the cartridge coil 5 which coiled about the straight angle line shown in drawing 4 (a) in the core cap 4 with which U typeface core 3 is insulated between coils, and inserts the opening side of U typeface core 3 in core insertion hole 4a of the core cap 4, and ] associate two U typeface cores 3 and combines in the noise filter of this invention, and it is formed. Cartridge coil 5a included in the core cap 4 and cartridge coil 5b form one common mode choke coil 1b of others [ d / of cartridge coils / cartridge coil 5c and / 5 ] again for one common mode choke coil 1a of drawing 1. In this invention, a capacitor 8 is connected to juxtaposition at common mode choke coil 1a of the compound common mode choke coil 1, and it is made to produce parallel resonance in the specific frequency of low frequency, and is made to be formed in the high impedance to the electrical potential difference in the common mode which flows in parallel on two lines in said specific frequency region with the inductances L1 and L2 of common mode choke coil 1a, and the capacity Cp of a capacitor 8. Moreover, the line and the capacitor 9 between touch-down between capacitor (CX)6between lines a of the input side of the compound common mode choke coil 1 of a high impedance characteristic of the aforementioned low frequency region and a compound common mode choke coil and an output side, 6b, and a line and a grounding terminal 10 (CY) constitute the noise filter circuit of pi mold, and the high magnitude of attenuation is obtained in the specific frequency of low frequency. Namely, the value of an inductance connects a capacitor 8 to the both ends of common mode choke coil 1a of L1 and L2. In a low frequency region, produce parallel resonance with the inductances L1 and L2 of a common mode choke coil, and the capacity Cp of a capacitor 8, and a line is made to produce a high impedance in a serial. Capacitor between lines (CX) pi mold filter circuit to a normal mode noise is formed between 6a and 6b, and pi mold filter circuit is formed to common mode noise between a line and the capacitor 9 between touch-down (CY). moreover, another side is common -- since an impedance is formed to the noise generating band whole region to the frequency of self-resonance which L3 and L4 of mode choke coil 1b have, the magnitude of attenuation is obtained in the noise generating band whole region by pi mold filter circuit by the capacitive low impedance of said impedance, capacitor (CX)6between lines a and 6b, and the line and the capacitor between touch-down 9 (CY).

[0009] Since the magnitude of attenuation of this noise filter compounds the magnitude of attenuation of said two pi mold filter circuits, it can be used as the cheap and small noise filter which has the property which compounded the good magnitude of attenuation in the whole region of the high magnitude of attenuation and a common mode choke coil in low frequency. moreover -- low frequency -- high -- the magnitude of attenuation -- center frequency -- and -- a band -- compound -- common -- the mode -- a choke coil -- one side -- common -- the mode -- a choke coil -- one -- a -- an inductance -- a value -- L -- one -- L -- two -- common -- the mode -- a choke coil -- juxtaposition -- connecting -- a capacitor -- (- CP --) -- eight -- a component -- a value -- changing -- things -- the resonance frequency of a low frequency region -- arbitration -- it can set up .

[0010] The above forms pi mold filter circuit to a normal mode noise like common mode noise by the leakage inductance which the compound common mode choke coil 1 has to a normal mode noise, and the capacitors 6a and 6b between lines, although common mode noise is explained.

[0011] Drawing 2 shows the face layout when mounting the filter circuit which constitutes the noise filter of this invention shown in drawing 1 on a printed circuit board 11. As shown in drawing 4, the compound common mode choke coil 1 compares an opening side so that it may become a closed magnetic circuit about two U typeface cores 3, it carries out insertion fitting of the U typeface core 3 at core insertion hole 4a of the core cap 4, and assembles and forms the cartridge coil 5 of rectangular copper wire in the core cap 4. A noise filter circuit is formed by connecting the capacitor 8 for making one common mode choke coil of a compound common mode choke coil produce parallel resonance in juxtaposition, the capacitors 6a and 6b between lines and a line and the capacitor between touch-down 9, and resistance 7 on a printed circuit board 11. In drawing 2, connection is carried out on a noise filter circuit and a printed circuit board also about the external connection terminal 2 and grounding terminal 10 of a noise filter.

[0012] Drawing 3 shows the damping property over the frequency of the noise filter in one example of the noise filter of this invention.

[0013] Each common mode choke coil 1a which constitutes the compound common mode choke coil 1 of drawing 1 in the damping property of the noise filter of drawing 3, The value of the inductance of 1b 1.8mH(s), coil 5 of common mode choke coil 1a a, The resistance 7 to which the value of 1000PF, and the line and the capacitor between touch-down 9 (CY) is 0.22 micro F, and the value of the capacitor (CP) 8 linked to the both ends of 5b connected the value of 4700PF and the capacitors 6a and 6b between lines for it between lines is discharge resistance for discharging the direct current voltage between lines. Moreover, by 50-ohm resistance, termination of an input side and the output side was carried out, and the connection terminal of the noise filter for measuring a damping property has measured them. In addition, in said example, although the value of each common mode choke coil 1a and 1b of the compound common mode choke coil 1 is set as the same value by 1.8mH(s), the number of turns of the cartridge coil of each common mode choke coil may be changed, the value of an inductance may be changed, respectively, and the capacity value of the capacitors 6a and 6b between lines and the capacity value of a line and the capacitor 9 between touch-down of the ability to choose suitably besides said numeric value are natural.

[0014] Moreover, although the example using the rectangle core which compared and combined the two-piece opening side showed U typeface core in the compound common mode choke coil of this invention It is made the compound common mode choke in which at least two or more pairs of common mode chokes were formed to the annular closed magnetic circuit core which has a high relative permeability property without the usual opening. Naturally it can consider as the noise filter which connected to juxtaposition the common mode choke coil and the capacitor which produces parallel resonance in low frequency to at least one pair of common mode choke coils.

[0015]

[Effect of the Invention] electromagnetism [ in / be / there are few components mark which constitute a noise filter compared with the former as explained above, and / it is small and / cheap and / a low frequency region ] -- the noise filter which was excellent in the damping property compared with the conventional noise filter to the noise can be offered now.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The filter circuit Fig. showing one example of the noise filter by this invention.

[Drawing 2] The top view showing one example of substrate mounting of the noise filter by this invention.

[Drawing 3] The property Fig. showing the damping property of one example of the noise filter by this invention.

[Drawing 4] The perspective view showing the configuration of the compound common mode choke coil which constitutes the noise filter by this invention. For drawing 4 (a), the appearance perspective view and drawing 4 (b) which show a cartridge coil are the decomposition perspective view of a compound common mode choke coil.

[Description of Notations]

- 1 Compound Common Mode Choke Coil
- 1a, 1b Common mode choke coil
- 2 External Connection Terminal
- 3 U Typeface Core
- 4 Core Cap
- 4a Core insertion hole
- 5, 5a, 5b, 5c, 5d Cartridge coil
- 6a, 6b Capacitor between lines
- 7 Resistance (Discharge Resistance)
- 8 Capacitor
- 9 Line and Capacitor between Touch-down
- 10 Grounding Terminal
- 11 Printed Circuit Board

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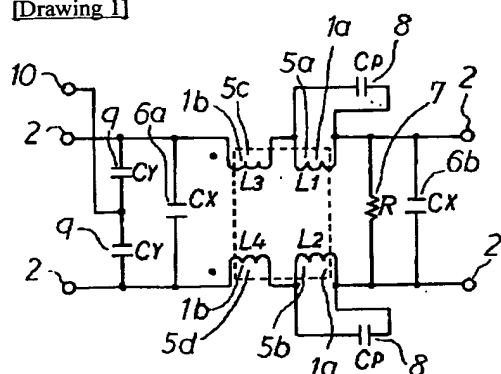
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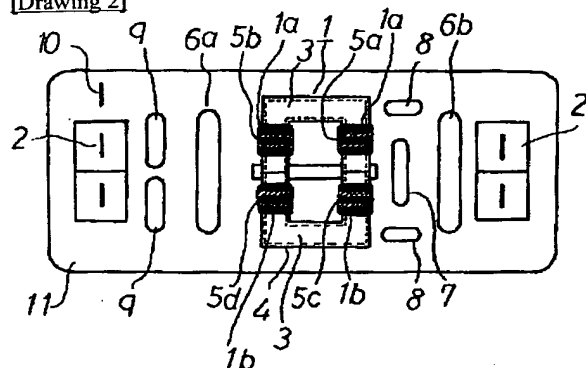
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## DRAWINGS

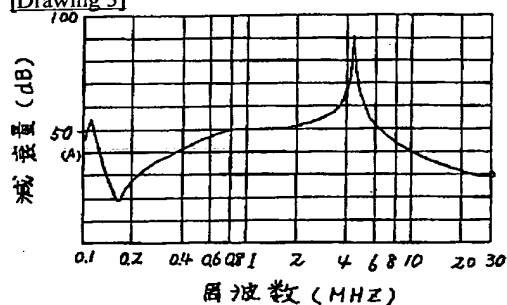
[Drawing 1]



[Drawing 2]

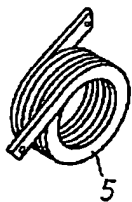


[Drawing 3]

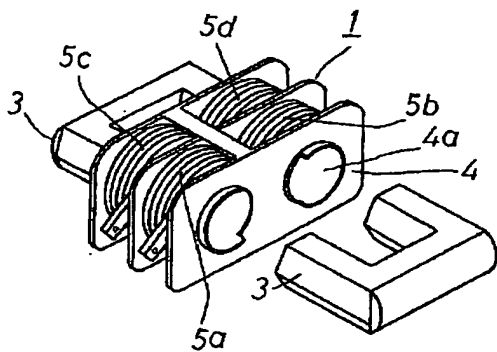


[Drawing 4]

(a)



(b)



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## P R E S E N T A B S T R A C T S O F J A P A N

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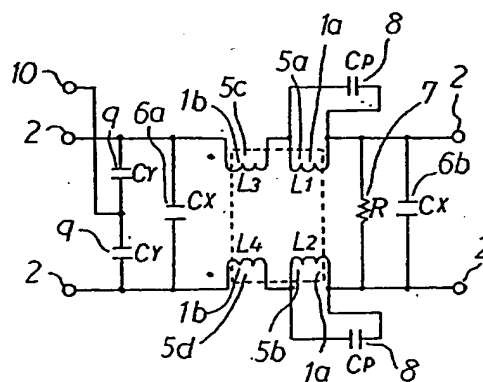
(72)Inventor : HARADA KIMIKI

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## (57)Abstract:

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**CONSTITUTION:** A composite common mode choke coil 1 (1a and 1b) with at least two pairs of windings wound around the magnetic core of one closed magnetic circuit and a capacitor 8 on both ends of a pair of wirings of the composite common mode choke coil 1. The noise filter is formed by connecting a line/earth capacitor 9 between the line and an earth terminal 10 on the input and output sides of a composite common mode choke coil 1 and line-to-line capacitors 6a and 6b between lines.





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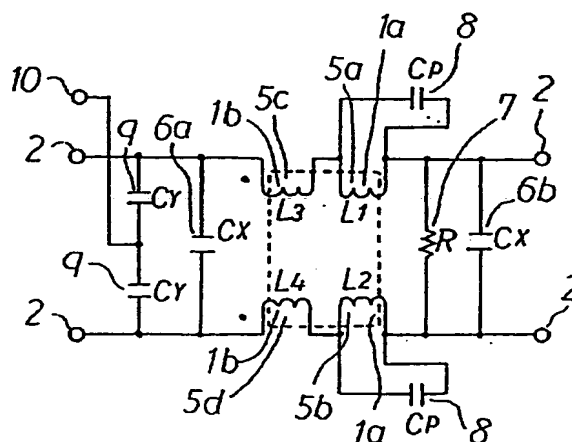
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(54)【発明の名称】 ノイズフィルタ

(57)【要約】

【目的】 対となる2つの線間と接地間に生ずるコモンモードの電磁ノイズを抑制するノイズフィルタにおいて、低周波域におけるコモンモード電磁ノイズと高周波域の電磁ノイズに共に抑制する効果が高く、かつ小形で安価なノイズフィルタを提供する。

【構成】 一つの閉磁路磁心に少なくとも2対以上の巻線を施した複合コモンモードチョークコイル1と、該複合コモンモードチョークコイル1の一対の巻線の両端にコンデンサ8を接続し、前記複合コモンモードチョークコイル1の入力側と出力側に線間とアース端子10との間に線・接地コンデンサ9と、線間に線間コンデンサ6a、6bを接続してノイズフィルタを形成する。



## 【特許請求の範囲】

【請求項 1】 高い比透磁率特性を有する閉磁路磁心に少なくとも 2 対以上のコモンモード巻線を施した複合コモンモードチョークコイルと、該複合コモンモードチョークコイルの少なくとも 1 対のコモンモード巻線の両端に接続したコンデンサと、前記複合コモンモードチョークコイルの入力側と出力側に接続した線間コンデンサと、線と接地間コンデンサとを接続してなることを特徴とするノイズフィルタ。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は電子機器に実装し、電磁ノイズを抑制するノイズフィルタに関するものである。

## 【0002】

【従来の技術】 従来のノイズフィルタを形成するコモンモードチョークコイルにおいてはトロイダルコアに手作業又は巻線機を用いて丸銅線を巻線していた。従来の此の種のノイズフィルタでは 1 つの高い比透磁率特性を有する閉磁路のトロイダルコアに 2 つの巻線をコモンモードに巻回したコモンモードチョークコイルとコンデンサや抵抗を接続して 1 つのノイズフィルタを形成している。一方低周波域の範囲までノイズ抑制効果が必要とされる場合には低周波域において高い減衰特性を必要とするノイズフィルタではインダクタンスの値の大きなコモンモードチョークコイルを組み込んだノイズフィルタと、高周波域で高い減衰特性を有するノイズフィルタの複数個のノイズフィルタを組合せ形成する必要がある形状が大きくなる。一方、2 つ以上のトロイダルコアの各々に巻線を施して 2 つ以上のコモンモードチョークコイルを回路に組み込むため、資材コストが高額になること、又組立作業性も悪く組み立ての工数も多く、極めて高価なノイズフィルタとなっていた。

## 【0003】

【発明が解決しようとする課題】 本発明はこれらの欠点を除去するため、低周波域で減衰特性が大きく、かつ小型で、かつ安価な生産性のよい低周波域から高周波域にわたる電磁ノイズを抑制するのに効果を有するノイズフィルタを提供することを目的とする。

## 【0004】

【課題を解決するための手段】 本発明は、U 字形コアの開口側を対向させて組合せ、矩形に底合し形成した 1 つの閉磁路磁性体の矩形コアに、平角銅線を巻回した円筒形の巻線を 2 対以上用いて、前記矩形コアの対向する磁脚に、前記巻線に逆向きに流れる電流の作る磁界が、互いに打ち消すようにする。一方、同一方向に流れる所謂コモンモードの電磁ノイズによる電流に対しては、高いインダクタンスを生ずるように巻回した少なくとも 2 つ以上のコモンモードチョークコイルを一つの閉磁気回路に形成した複合コモンモードチョークコイルとする。前記複合コモンモードチョークコイルの 2 つ以上のコモン

モードコイルの夫々の矩形コアの磁脚に巻回した巻線を直列に接続する。1 つのコモンモードチョークコイルにはチョークコイルに並列にコンデンサを接続してコンデンサと並列共振回路を構成する。低周波域の特定周波数帯において、高いインピーダンスを有するように作用させ、かつ他方の 1 つのコモンモードチョークコイルは、巻線間の浮遊容量による自己共振を生ずる迄の周波数域にわたりノイズ発生周波数帯全域においては、高いインピーダンスを有するように作用させたものである。更に

- 10 前記の複合コモンモードチョークコイルに対して  $\pi$  型に、2 つの線間にコンデンサを接続する。またラインアース間にコンデンサを逆し型フィルタを構成するように接続し、ローパスフィルタ型の回路を構成することにより、低周波の特定周波数帯に対して高い減衰特性を有し、又高い周波数域迄の電磁ノイズを抑制し、安価で、かつ小形に実現できるノイズフィルタを構成する。本発明のノイズフィルタは、複合コモンモードチョークコイルに接続するコンデンサの接続の前後は、反転して組み込むことも可能である。又電磁ノイズの周波数帯により、電磁ノイズを抑制するための複合コモンモードチョークコイルの 1 つごとのコモンモードチョークコイルをインダクタンスの異なるコモンモードチョークコイルにする。またコンデンサの定数を変えることによりノイズ発生周波数成分に応じ任意に周波数帯域の減衰特性の異なるものとする事が可能である。

- 30 【0005】 即ち本発明は、高い比透磁率特性を有する閉磁路磁心に少なくとも 2 対以上のコモンモード巻線を施した複合コモンモードチョークコイルと、該複合コモンモードチョークコイルの少なくとも 1 対のコモンモード巻線の両端に接続したコンデンサと、前記複合コモンモードチョークコイルの入力側と出力側に接続した線間コンデンサと、線と接地間コンデンサとを接続してなることを特徴とするノイズフィルタである。

## 【0006】

- 【作用】 U 字形コアの開口側をつき合わせ組合せた矩形コアと、矩形コアに形成された 2 対のコモンモードチョークコイルの一方の磁脚に巻回された 2 つの巻線を直列に接続し、矩形コアの対向する磁脚に巻回した一つのコモンモードチョークコイルに並列に低周波域で並列共振を生ずるよう接続したコンデンサは、低周波域においてコモンモードチョークコイルに流れる低周波成分の電磁ノイズに対して高いインピーダンスを生ずるようになる。また一方矩形コアの磁脚に形成した少なくとも 2 対以上のコモンモードチョークの対向する夫々の磁脚に巻回した巻線を、直列に接続した複合コモンモードチョークコイルの入力側と出力側の 2 つの線間に、コンデンサを接続する。又 2 つの線と接地間にコンデンサを接続した構成としてあるので、線に流れる電流に対し高いインピーダンスとする 1 つのコモンモードチョークに並列に接続したコンデンサによって生ずる並列共振周波数域を除
- 40
- 50

き、複合コモンモードチョークコイルのインダクタンスと、入力側と出力側との線間に接続されたコンデンサと、及び2つの線の夫々と接地側との間のコンデンサと、2つの線間のノーマルモード電磁ノイズと、2つの線と接地側との間に生ずるコモンモード電磁ノイズを抑制するノイズフィルタとを構成する。又2つのコモンモードチョークコイルに夫々コンデンサを組合せた減衰周波数域の異なる2つのノイズフィルタを組合せてノイズフィルタとした構成としていないので、ノイズフィルタを形成するコンデンサの数が少なくなり、又ノイズフィルタの全体の大きさ、及び部品を組立てる際の組立て工数も従来に比べて少なくなり、小形で安価な低周波域と高周波域で減衰特性の大きなノイズフィルタを構成することが出来る。

【0007】

【実施例】本発明のノイズフィルタの一実施例を図面を用いて説明する。

【0008】図1に本発明のノイズフィルタを構成する回路の一実施例を示す。本発明のノイズフィルタにおいては、複合コモンモードチョークコイル1は図4(b)に示すように図4(a)に示す平角線を巻き回した筒形巻線5を巻線間とU字形コア3とを絶縁するコアキャップ4に組込んでなるもので、コアキャップ4のコア挿入孔4aにU字形コア3の開口側を挿入し、2つのU字形コア3をつき合わせ組合せて形成される。コアキャップ4に組み込まれる筒形巻線5aと、筒形巻線5bは図1の1つのコモンモードチョークコイル1aを、筒形巻線5cと筒形巻線5dは、又他の1つのコモンモードチョークコイル1bを形成する。本発明においては複合コモンモードチョークコイル1のコモンモードチョークコイル1aに並列にコンデンサ8を接続し、コモンモードチョークコイル1aのインダクタンス $L_1$ 、 $L_2$ と、コンデンサ8の容量 $C_p$ によって低周波の特定周波数において並列共振を生ずるようにし、前記特定周波数域において2つの線に並行に流れるコモンモードの電圧に対して高いインピーダンスが形成されるようにしてある。又前記の低周波域の高いインピーダンス特性の複合コモンモードチョークコイル1と、複合コモンモードチョークコイルの入力側と出力側の線間コンデンサ( $C_x$ )6a、6bと、線とアース端子10との間の線・接地間コンデンサ9( $C_y$ )とにより $\pi$ 型のノイズフィルタ回路を構成し低周波の特定周波数において高減衰量が得られる。即ちインダクタンスの値が $L_1$ 、 $L_2$ のコモンモードチョークコイル1aの両端にコンデンサ8を接続して、コモンモードチョークコイルのインダクタンス $L_1$ 、 $L_2$ とコンデンサ8の容量 $C_p$ とにより低周波域において並列共振を生じさせて高いインピーダンスを線に直列に生じさせ、線間コンデンサ( $C_x$ )6a、6bとの間でノーマルモードノイズに対する $\pi$ 型濾波回路を形成し、線・接地間コンデンサ( $C_y$ )9との間でコモンモードノイズに対

し $\pi$ 型濾波回路を形成する。又他方のコモンモードチョークコイル1bの $L_1$ 、 $L_2$ の持つ自己共振の周波数迄のノイズ発生帯域全域に対しインピーダンスが形成されるので、前記インピーダンスと線間コンデンサ( $C_x$ )6a、6bと線・接地間コンデンサ( $C_y$ )9の容量性低いインピーダンスによる $\pi$ 型濾波回路によりノイズ発生帯域全域において減衰量が得られる。

【0009】本ノイズフィルタの減衰量は前記2つの $\pi$ 型濾波回路の減衰量を合成したものであるから、低周波において高減衰量及びコモンモードチョークコイルの全域において良好な減衰量を合成した特性を有する安価でかつ小形のノイズフィルタとすることが出来る。又、低周波の高減衰量の中心周波数及び帯域も複合コモンモードチョークコイルの一方のコモンモードチョークコイル1aのインダクタンスの値 $L_1$ 、 $L_2$ とコモンモードチョークコイルに並列に接続するコンデンサ( $C_p$ )8の素子値を変化することにより低周波域の共振周波数を任意に設定できる。

【0010】以上はコモンモードノイズについて説明したものであるがノーマルモードノイズに対して複合コモンモードチョークコイル1の持つ漏洩インダクタンスと線間コンデンサ6a、6bとにより、コモンモードノイズと同様に、ノーマルモードノイズに対して $\pi$ 型濾波回路を形成する。

【0011】図2は図1に示す本発明のノイズフィルタを構成する濾波回路を、プリント基板11上に実装した時の実装図を示している。複合コモンモードチョークコイル1は、図4に示すように2つのU字形コア3を開磁路になるよう開口側を突き合わせ、コアキャップ4のコア挿入孔4aにU字形コア3を挿入嵌合し、平角銅線の筒形巻線5をコアキャップ4に組立てて形成する。複合コモンモードチョークコイルの一方のコモンモードチョークコイルに並列に並列共振を生じさせるためのコンデンサ8及び線間コンデンサ6a、6b及び線・接地間コンデンサ9、抵抗7をプリント基板11上で結線することによりノイズフィルタ回路を形成する。図2においてノイズフィルタの外部接続端子2及びアース端子10についてもノイズフィルタ回路とプリント基板上で結線される。

【0012】図3は本発明のノイズフィルタの一実施例におけるノイズフィルタの周波数に対する減衰特性を示す。

【0013】図3のノイズフィルタの減衰特性において、図1の複合コモンモードチョークコイル1を構成する夫々のコモンモードチョークコイル1a、1bのインダクタンスの値は1.8mH、コモンモードチョークコイル1aの巻線5a、5bの両端に接続したコンデンサ( $C_p$ )8の値は1000PF、線・接地間コンデンサ( $C_y$ )9の値は4700PF、線間コンデンサ6a、6bの値は0.22 $\mu$ Fであり、線間に接続した抵抗7

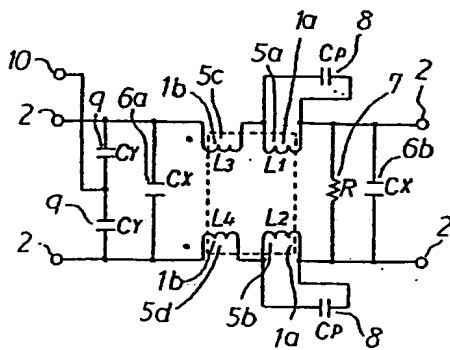
は線間の直流電圧を放電するための放電抵抗である。又減衰特性を測定するためのノイズフィルタの接続端子は、入力側、出力側共  $50\Omega$  の抵抗で終端し測定している。なお、前記実施例において、複合コモンモードチョークコイル 1 の夫々のコモンモードチョークコイル 1 a、1 b の値は  $1.8\text{mH}$  で同じ値に設定してあるが、夫々のコモンモードチョークコイルの筒形巻線の巻数を変えてインダクタンスの値を夫々変えてもよく、線間コンデンサ 6 a、6 b の容量値、線・接地間コンデンサ 9 の容量値は前記数値の他、適宜選択し得ることは当然である。

【0014】又本発明の複合コモンモードチョークコイルでは U 字形コアを 2 個開口側を突き合わせて組合せた矩形コアを用いた例で示したが、通常の空隙のない高い比透磁率特性を有する環状閉磁路磁心に少なくとも 2 対以上のコモンモードチョークを形成した複合コモンモードチョークにし、少なくとも 1 対のコモンモードチョークコイルに低周波においてコモンモードチョークコイルと並列共振を生ずるコンデンサを並列に接続したノイズフィルタとし得ることは当然である。

【0015】

【発明の効果】以上説明したように、従来に比べてノイズフィルタを構成する部品点数が少なく、小形で安価な、かつ低周波域における電磁ノイズに対して従来のノイズフィルタに比べて減衰特性に優れたノイズフィルタが提供出来るようになった。

【図 1】



【図面の簡単な説明】

【図 1】本発明によるノイズフィルタの一実施例を示す濾波回路図。

【図 2】本発明によるノイズフィルタの基板実装の一実施例を示す平面図。

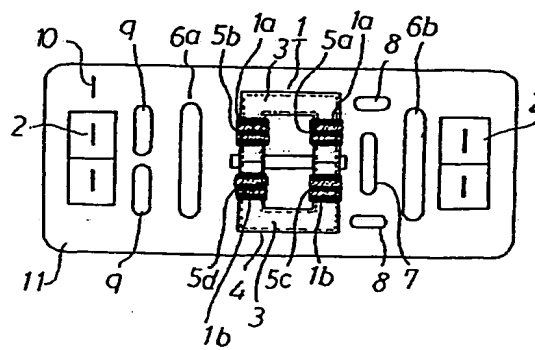
【図 3】本発明によるノイズフィルタの一実施例の減衰特性を示す特性図。

【図 4】本発明によるノイズフィルタを構成する複合コモンモードチョークコイルの構成を示す斜視図。図 4 (a) は筒形巻線を示す外観斜視図、図 4 (b) は複合コモンモードチョークコイルの分解斜視図。

【符号の説明】

- 1 複合コモンモードチョークコイル
- 1 a, 1 b コモンモードチョークコイル
- 2 外部接続端子
- 3 U 字形コア
- 4 コアキャップ
- 4 a コア挿入孔
- 5, 5 a, 5 b, 5 c, 5 d 筒形巻線
- 6 a, 6 b 線間コンデンサ
- 7 抵抗 (放電抵抗)
- 8 コンデンサ
- 9 線・接地間コンデンサ
- 10 アース端子
- 11 プリント基板

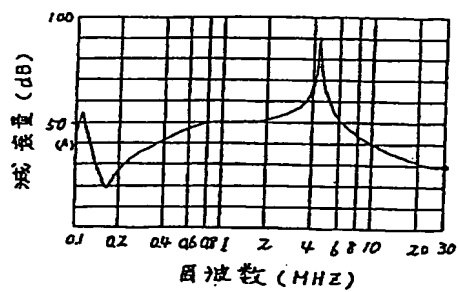
【図 2】



(5)

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【図3】



【図4】

(a)



(b)

